

A.D. 1885, 31st MARCH. N° 4068.

PROVISIONAL SPECIFICATION.

Improvements in the Manufacture of Beer and Malt Liquors,  
and in Apparatus for the Treatment and Preparation of  
Materials for the same.

I, WILLIAM LAWRENCE, of 22 St Mary Axe, in the City of London, Engineer, do hereby declare the nature of said invention for IMPROVEMENTS IN THE MANUFACTURE OF BEER AND MALT LIQUORS AND IN APPARATUS FOR THE TREATMENT AND PREPARATION OF MATERIALS FOR THE SAME, to be as follows:—

- 5 The improvement has reference to a new process of treating diastatic or malted grain whereby the process of brewing may be conducted so as to produce a purer and better alcohol and a peptonic and digestive beer possessing a distinctive character and unlike English ordinary beer inasmuch as to be highly stimulating yet very much less intoxicating than English ale.
- 10 The process includes the grinding of the malt or grain, the mashing and the heating and treating of the mash, the boiling of the "worts," the straining and drawing off of the "worts" and the fermenting of the extract or "worts," also machinery and apparatus for performing the same, also the product, or the malt liquor.
- 15 The novelty of the process may be best seen by describing the system as at present employed in brewing in England both in the manufacture of the ordinary English or "upper fermentation" beer and in the "Lager" or "under fermentation" beer and then comparing these systems with my new process.
- 20 Then to commence with, ordinary English or "upper fermentation" beer. The "mashing" process is conducted at high temperatures so that the mean heat of the mash when the malt or "grist" is mixed with the mashing water shall be say above 140° and below 156°. This kind of mashing as carried out in England produces a yeast or ferment—that is after the yeast has successively been used or passed through a few brewings—such as is known as English upper fermentation
- 25 yeast. The temperature at commencing such fermentation being about 60° more or less and the beer resulting being the ordinary English beer.

On this system of "mashing" the strength of the yeast is not so great as that kind of yeast preferred by bakers to make bread with, or what is known as "French" yeast. The German or Lager beer as made in England differs considerably in the mashing process from the English system, and consists generally

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*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

of mashing at a temperature so as to make a thick or initial mash at about 100° to 115° Fahrenheit or thereabouts; then to take out a portion of this initial mash and boil it for a time and put it back again to the other part, bringing the temperature to about 140° or more, then by taking out another part and boiling it and returning it, to bring the temperature of the whole mash to about 160° more or less. This system of mashing requires the fermentation to be carried on at low temperatures and the resulting beer has to be matured in ice cellars and is what is known as ordinary "Lager" beer. The new product is brewed unlike either of the above described plans.

*1/2 of the  
patented  
pressure*

The mash is made in my new process on the first or initial mash at a temperature of from about 100° to 115° Fahrenheit and allowed to stand at such temperatures for about half an hour more or less. The mash is then passed through pipes or chambers and subjected to alternating pressures and velocity in such a manner that the starch and other cells become mostly burst and in the pressure of the diastase of the malt leaving the diastase at the same time practically intact. The process being also very rapid the formation of acidity is prevented in the mash. Acidity would result very rapidly were the mash allowed to stand any temperatures from 120° to 130° more or less. But the mash being so rapidly heated from the temperature of about 110° to 140° or 145°, and at the same time the mechanical pressure put upon it and the abrading shattering effect and the jarring and the alternating pressure and velocity to which the mash is subjected as it passes through the apparatus, put it to such an ordeal that the cells of starch &c such as are detached or broken out of the matrix in the process of grinding or crushing the malt, become burst at once in the presence of the diastase. The mash is then allowed to stand for half an hour more or less and then passed again through the apparatus so as to break up the remaining starch cells as much as possible and cause a converting action, or it may be passed several times through the apparatus but the resulting temperature should be say from 150° to 155° more or less according to circumstances.

The extract may be then drawn off in the usual way and if it is found to contain the requisite amount of dextrine, of the right kind, the wort may be run over a heating apparatus to boil it and coagulate the principal part of the albumenoids, or those that coagulate before the boiling temperature of 212°, and this coagulated matter may be separated by filtration before the wort enters the copper and be saved as a food for cattle.

The "wort" resulting will be much more fermentable than a wort prepared by the ordinary hot mash English system but it will be free from the albumenoids that are peptonized by the German system of boiling the "mash." The strength also of the yeast resulting will be very much greater than the ordinary English yeast and after it has passed through a few successive fermentations will resemble the "French" yeast for power. But a yeast obtained from France may be used in the first or initial brewing and so the normal condition of the yeast will be at once or more quickly attained. A much less quantity of yeast must be used than when the mash is made on the English system—that is—instead of using 2 lbs per barrel it will be found sufficient to use only  $\frac{3}{4}$  lbs per barrel. The fermentation must also be conducted in small quantities or it may be conducted in the casks in which the beer is sent out.

When all my process is properly carried out a distinctive beer is produced being very free from acidity and possessing good keeping qualities, being highly stimulating but much less intoxicating than ordinary English beer, and yet at the same time digestive or peptonic. But the fermentation must be carefully conducted and the temperature at say 60° more or less according to circumstances, at commencement, and attaining at the highest point about 68° more or less.

In the storing of the beer it must not be allowed to make too much gas so as to put much pressure on the casks or induce a secondary fermentation, or an after fermentation of too strong a nature but the ripening or maturing after fermentation should be conducted slowly and held in check. The fermentation should be

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

- conducted by a special process in a special apparatus described further on. Apparently my process does not differ greatly from a process carried on in France, in which the initial mash is made, as in my process namely at about 110°, and afterwards raised by degrees by mixing hot water with it until the saccharising temperature is arrived at or about 145°, and then by adding more hot water the temperature of the mash is raised finally to a temperature below 167°, or the heat at which diastase is rendered inert. But although the process appears similar to mine, the beer resulting is of a very different character being of a very inferior kind as compared with beer by my process and very unstable while the "worts" contain a large amount of that kind of dextrine known as low dextrine or those kinds of dextrines that are near to starch as well also as a considerable quantity of liquid or other starch. In reality then my process is very different in the results as by the mechanically breaking of the starch and other cells the dextrines obtained are those near to maltose or the high dextrines, while the mash is purified by the process. This constitutes then a complete difference between my process and the French process. The beer resulting from the French process is of a very low or ordinary and inferior character while the beer resulting from my process is so delicate as to approach more to the delicacy of a wine. Then again as compared with English beer the alcohol contained is of a very delicate kind by my process and quite unlike the coarse alcohols which are found to be mixed with the alcohol contained in English beer or the amyl-alcohol or Fusil oil. My beers at the same time may be made of such a low gravity as to commend themselves to all lovers of temperance, also to meet the requirements of those who prefer to drink moderately without becoming intoxicated. So different then is my product to ordinary English beer, and yet this great difference is made not by low or "under" fermentation, as that carried on in Germany, but by cultivating the action of the germinating diastatic action on the albumenoids and then destroying the cells or organisms and bursting the starch cells so as to produce the delicate dextrines near to maltose; such treatment helps to give a delicacy of wine to my beer. But in carrying out my process of brewing there are practical difficulties and mechanical difficulties to overcome, and to overcome these I prefer to employ certain machinery and apparatus through all the stages. Now in describing this apparatus the object for which I require it must be borne in mind. I have in the first place to submit the malt or grist, while in a moist or mashed state, to allow the vital germinating diastatic action to modify the albumenoids &c. And secondly to raise the temperature suddenly, passing it through those dangerous temperatures which are some degrees below 140° and above 115°, and in so doing to destroy all vital or germination action, and to break up the cells of starch or the other cells or organisms, also in order to obtain a bright or filtered "wort" and to overcome the difficulties presented in draining or drawing off such "wort."
- To commence then with the grinding.
- The grinding may be so modified or conducted as to cause a modification in the first and second processes of mashing. When malt is ground in the ordinary way the hard or "steely" parts break up in lumps—that is to say the lumps—or masses of starch cells embedded in the matrix—are one portion of the grist and the tender or well malted parts that become well crushed form the other portion. Now if these steely parts were by a more correct system of grinding completely broken up the second process or raising the mash to above 140° and the mechanical means employed would break up the starch cells and other cells so as to obviate the necessity of another process to effect the purpose. Also if by the grinding in a pasty condition the malt or grain mash at a temperature of say 100° Fahrenheit the saccharising effect could then afterwards be produced without subjecting the mash to so much pressure or mechanical effect in the converting apparatus, as when the malt had not been so completely ground—also in the pasty condition the mash could be forced through an apparatus and while the heat was raised the starch cells may be burst by abrading and diastatic action, and the saccharine extract pressed out in a concentrated state leaving the further operation of brewing and fermenting to be carried on by any one at a future time. Now as regards the grinding the

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

chief difficulty is the breaking up the matrix of the grain without too much breaking up the husk or spoiling the drainage. The grinding thus described has reference then to grinding the malt or grist commencing with a process of dry grinding and completing the process as a wet process of grinding, or the malt or grist may be soaked to toughen the husk and then ground in a sufficient quantity 5 of water to prevent the grist from clogging up the mill. This grinding process may include the screening by gravitation in water and the washing of the husk. It may also include special mills or several pairs of rollers arranged in sets so that the malt or grist may pass through more than one set of rollers. Also the grinding process may include a "kibbling" machine and a kneading machine. The apparatus 10 for mechanically bursting the starch cells &c may consist of plunging or pumping or a screw-delivering apparatus to deliver and propel the mash made with more or less water, and from the consistence of a mere paste to that of an ordinary mash, where two barrels of water are used to one quarter of malt. The apparatus to propel the pasty mash may be constructed to heat the mash in its passage through 15 the apparatus and at the same time by an abrading action cause the bursting of the cells by the particles rubbing one upon the other while the mass is being propelled through chambers or cones of varying sectional areas. Or the apparatus may consist of an injector system such as described in my patents N° 4277 of 8 September 1882 and N° 1205 of 6 March 1883 for mechanically bursting the starch cells in the 20 presence of the diastase of the malt without destroying the latter.

The straining and filtering process has reference in the first place to forcing air or any gas into the mash or purified air, or passing air into the mash as it is being treated or is passing through the converting apparatus. The object of passing air into the mash being to buoy up the mash so that it may be rendered porous and 25 light and act as a filter bed. The filtering or pressing process also has reference to constructing an attachment or auxiliary to the converting apparatus or separating or filtering apparatus or arrangement, so that the liquid may be strained or forced or pressed away from the solid part—more or less and in a clear or semi-clear condition—so as to leave the cellulose &c in the "draff" or "grains." This 30 separating or filtering arrangement may be a press of any kind such as is already in use for other purposes, or any special one, and into which the converted mash whether in the thick or the thin state may be delivered under any suitable pressure. It may also be constructed of perforated pipes chambers or cones through which the mash is made to travel in a continuous form in its passage out of the con- 35 verting apparatus. Or rings of metal placed one upon the other, leaving the spaces between them for filtering the liquid away, the rings may have milled or serrated edges to present very fine spaces or voluted or spiral springs, or rings made for instance, by screwing a cylinder and boring away the internal part leaving a spiral piece of metal as the only remaining part—Or chambers or pipes 40 may be lined with fibrous or hair like arrangements disposed in the direction of the flow of the "mash." All such chambers, pipes or arrangements may have regulating cocks or valves to regulate the amount of liquid to be strained or pressed away. The strained liquid may be returned to be mixed with fresh mash or malt or grist and so form a very concentrated extract or such a concentration of the 45 extract as may be desired.

The straining or pressing or filtering process may also include the rewashing of the "draff" or "grains" after the first pressing and then pressing again so as to deliver the "grains," after being freed from the saccharine extract, finally in a pressed state. Also in the washing may be included the separating of some of the 50 husky part from the grains so as to make them in a more convenient and portable form as food for cattle, leaving the rough husky part for any other convenient purpose. The fermenting process may include apparatus consisting of a combination or set of casks having a "back" placed over them and a "swan neck" pipe arrangement such as is in vogue at the present time in Burton on Trent and 55 known as the Burton Union system. But in the place of the "back" above the casks being intended and used as a "back" to contain the yeast, the "back" is to

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be constructed for the purpose of containing about one third more or less as much fermenting beer as is contained in the casks. In the action of this apparatus the yeast from the cask continually is being discharged into the "back" and thereby increasing the quantity of yeast in proportion to the beer contained in the "back."

- 5 This causes the fermentation in the "back" to proceed more rapidly than the beer in the casks and to finish quicker and settle before the beer in the casks has finished therefore to form a constant supply to fill up the casks with bright beer. It is intended to put into this "back" any suitable attenuator for regulating the temperature. By this process of fermentation the large amount of yeast that  
10 accumulates in the "back" does not injure the fermentation to produce a "yeast bite" but on the other hand overcomes the difficulty in a great measure attendant upon fermentation.

- Having thus shown the general nature of my invention I also state that any modification of the mashing process whereby the mash or moistened malt is  
15 subjected for a shorter period than half an hour to these low temperatures desirable for transforming the albumenoids under the vital or diastatic action that takes place at a lower temperature than that at which germs or spores in the malt are destroyed, form a modification of my process and produce a modified beer. Even if the mash is only exposed or the malt is soaked before grinding only for a few  
20 minutes, and then passed through the converting apparatus so as to give the desired temperature and to rupture the starch cells, and cleanse the mash by destroying any organisms, then such treatment forms a part of my process. Finally my process includes the use in the preparation of the "wort" for fermentation, of saccharine or maltose extract containing the proper proportion and condition of  
25 dextrine of the high class or those dextrines near to maltose, and containing also the requisite quantity and condition of albumenoid substance that has been modified by the action of submitting malt extract or mash to the action of diastase or such action as takes place in mashed or soaked malt when submitted to the initial process of mashing at low temperatures or those below 115° or thereabouts.  
30 It is the fermenting of such extract that actually constitutes the making of the beer and the actually carrying out my process. But as such extract is not a commercial commodity and cannot at present be purchased the brewer must manufacture it for himself until such is manufactured for him. It follows then that the preparation of the extract and the fermenting of the extract are both parts of the  
35 same process and the beer as before described cannot be produced unless the extract is first prepared and then afterwards fermented. But inasmuch as the extract may be prepared by or through one person and the fermentation be conducted by another, that in order to protect the inventor from infringement such a means of circumventing be not permissible, and the process not be split up into the  
40 preparation at a certain time and place or by one person the extract and the fermenting it at or by another.—I must also state that so little is at present absolutely known in the science of chemistry about the chemistry of the dextrines and the albumenoids that to give the chemical composition of the wort that will express distinctly the condition of these bodies in the "worts" or extract it is not  
45 I believe competent for any chemist or for me to give. With regard to the making of spirit it is only necessary to distil such fermented "wort" as has been before described by any ordinary distilling apparatus. But as regards the temperature of such fermentation that may be modified as well as the quantity of yeast employed, also distillers who do not produce their own yeast would have to  
50 purchase it as in the ordinary way.

Dated this 31st day of March 1885.

HERBERT & Co.,  
Agents.

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

## COMPLETE SPECIFICATION.

**Improvements in the Manufacture of Beer and Malt Liquors,  
and in Apparatus for the Treatment and Preparation of  
Materials for the same.**

I, WILLIAM LAWRENCE of 22 St Mary Axe, in the City of London, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

The improvement has reference to a new process of treating diastatic or malted 5 grain whereby the process of brewing may be conducted so as to produce a purer and better alcohol and a peptonic and digestive beer possessing a distinctive character and unlike English ordinary beer inasmuch as to be highly stimulating yet very much less intoxicating than English ale.

The process includes the grinding of the malt or grain, the mashing and the 10 heating and treating of the mash, the boiling of the "worts" the straining or drawing off of the "worts" and the fermenting of the extract or "worts," also machinery and apparatus for performing the same also the product, or the malt liquor.

The novelty of the process may be best seen by describing the system as at 15 present employed in brewing in England both in the manufacture of the ordinary English or "upper fermentation" beer and in the "Lager" or "under fermentation" beer and then comparing these systems with my new process.

Then to commence with ordinary English or "upper fermentation" beer the "mashing" process is conducted at high temperatures so that the mean heat of the 20 mash when the malt or "grist" is mixed with the mashing water shall be say above 140 and below 156°. This kind of mashing as carried out in England produces a yeast or ferment—that is after the yeast has successively been used or passed through a few brewings—such as is known as English upper fermentation yeast. The temperature at commencing such fermentation being about 60° more 25 or less and the beer resulting being the ordinary English beer.

On this system of "mashing" the strength of the yeast is not so great as that kind of yeast preferred by bakers to make bread with or what is known as "French" yeast. The German or Lager beer as made in England differs considerably in the mashing process from the English system and consists generally of 30 mashing at a temperature so as to make a thick or initial mash at about 100° to 150° Fah. or thereabouts then in the usual way to take out a portion of this initial mash and boil it for a time and put it back again to the other part bringing the temperature to about 140° or more then by taking out another part and boiling it and returning it to bring the temperature of the whole mash to about 160° more or 35 less. This system of mashing requires in the usual way the fermentation to be carried on at low temperatures and the resulting beer has to be matured in ice cellars and is what is known as ordinary "Lager" beer. The new product is brewed unlike either of the above described plans and it includes both a new product referred to as the "Distinctive" beer and also a modified beer as herein- 40 after described.

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

For the distinctive beer the mash is made in my new process in the first or initial mash at a temperature of from about 100 to 115° Fah: and allowed to stand at such temperatures for about half an hour more or less. The mash is then passed through pipes or chambers and subjected to alternating pressures and velocity in such a manner that the starch and other cells become mostly burst and in the presence of the diastase of the malt leaving the diastase at the same time practically intact. The process being also very rapid the fermentation of acidity is prevented in the mash. Acidity would result very rapidly were the mash allowed to stand at any temperatures from 120 to 130 more or less. But the mash being so rapidly heated from the temperature of about 110° to from 145 to about 165° and at the same time the mechanical pressure put upon it and the abrading shattering effect and the jarring and the alternating pressure and velocity to which the mash is subjected as it passes through the apparatus put it to such an ordeal that the cells of starch &c such as are detached or broken out of the matrix in the process of grinding or crushing the malt, become burst at once in the presence of the diastase. The mash is then allowed to stand for half an hour more or less and then passed again through the apparatus if necessary so as to break up the remaining starch cells as much as possible that may become detached from the matrix or unconverted lumpy parts and cause a converting action or it may be passed several times through the apparatus but the resulting temperature should be say from 150 to say 160 more or less according to circumstances.

The extract may be then drawn off in the usual way and if it is found to contain the requisite amount of dextrine of the right kind the wort may be run over a heating apparatus to boil it and coagulate the principal part of the albumenoids or those that coagulate before the boiling temperature of 212° and this coagulated matter may be separated by filtration before the wort enters the copper and be saved as a food for cattle. The "wort" resulting will be much more fermentable than a wort prepared by the ordinary hot mash English system but it will be more free from those albumenoids such as are peptonized by the German system of boiling the "mash." The strength also of the yeast resulting will be very much greater than the ordinary English yeast and after it has passed through a few successive fermentations will resemble the "French" yeast for power. But a yeast obtained from France should be used in preference in the first or initial brewing and so the normal condition of the yeast will be at once or more quickly attained. A much less quantity of yeast must be used than when the mash is made on the English system—that is—instead of using 2 lbs per barrel it will be found sufficient to use only  $\frac{3}{4}$  lbs per barrel. The fermentation must also be conducted in small bulks or quantities or it may be conducted in the casks in which the beer is sent out.

When this particular process is properly carried out a distinctive beer is produced being very free from acidity and possessing good keeping qualities being highly stimulating but much less intoxicating than ordinary English beer and yet at the same time digestive or peptonic. But the fermentation must be carefully conducted and the temperature at say 60° more or less according to circumstances at commencement and attaining at the highest point about 68° more or less. In the storing of the beer it must not be allowed to make too much gas so as to put much pressure on the casks or induce a secondary fermentation or an after fermentation of too strong a nature but the ripening or maturing after fermentation should be concluded slowly and held in check. The fermentation should be conducted by a special process in a special apparatus described further on. Apparently my process does not differ greatly from a process carried on in France in which the initial mash is made as in my process namely at about 110° and afterwards raised by degrees by mixing hot water with it until the saccharising temperature is arrived at or about 145° and then by adding more hot water the temperature of the mash is raised finally to a temperature below 167°. But although the process appears similar to mine the beer resulting is of a very different character being of a very inferior kind as compared with beer by my

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

process and very unstable while the "worts" contain a large amount of that kind of dextrine known as low dextrine or those kinds of dextrines that are near to starch as well also as a considerable quantity of liquid or other starch. In reality then my process is very different in the results as by the mechanically breaking of the starch and other cells the dextrines obtained are those near to maltose or the high dextrines while the mash is purified by the process. This constitutes then a complete difference between my process and the French process. The beer resulting from the French process is of a very low or ordinary and inferior character while the beer resulting from my process is so delicate as to approach more to the delicacy of a wine. Then again as compared with English beer the alcohol contained is of a very delicate kind by my process and quite unlike the coarse alcohols which are found to be mixed with the alcohol contained in English beer or the Amyl-alcohol or Fusil oil. My beers at the same time may be made of such a low gravity as to commend themselves to all lovers of temperance also to meet the requirements of those who prefer to drink moderately without becoming intoxicated. So different then is my product to ordinary English beer and yet this great difference is made not by low or "under" fermentation as that carried on in Germany. But by cultivating the action of the germinating diastatic action on the albumenoids and then destroying the cells or organisms and bursting the starch cells so as to produce the delicate dextrines near to maltose such treatment helps to give a delicacy of wine to my beer. But in carrying out my process of brewing there are practical difficulties and mechanical difficulties to overcome and to overcome these I prefer to employ certain machinery and apparatus through all the stages. Now in describing this apparatus the object for which I require it must be borne in mind. I have in the first place to submit the malt or grist while in a moist or mashed state to allow the vital germinating diastatic action to modify the albumenoids &c and secondly to raise the temperature suddenly passing it through those dangerous temperatures which are some degrees below 130° and above 115° and in so doing to destroy all vital or germinating action and to break up the cells of starch or the other cells or organisms also in order to obtain a bright or filtered "wort" and to overcome the difficulties presented in draining or drawing off such "wort." To commence then with the grinding. The grinding may be so modified or conducted as to cause a modification in the first and second processes of mashing. When malt is ground in the ordinary way the hard or "steely" parts break up in lumps—that is to say—the lumps or masses of starch cells embedded in the matrix—are one portion of the grist and the tender or well malted parts that become well crushed form the other portion. Now if these steely parts were by a more correct system of grinding completely broken up the second process or raising the mash to above 140° the mechanical means employed would break up the starch cells and other cells so as to obviate the necessity of another process to effect the purpose so that the mash might be raised from 110° to say 158° more or less at one operation. Also by the grinding in a pasty condition the malt or grain mash at a temperature of say 100° Fah: the saccharising effect could then afterwards be produced without subjecting the mash to so much pressure or mechanical effect in the converting apparatus as when the malt had not been so completely ground. Also in the pasty condition the mash could be forced through an apparatus and while the heat was raised the starch cells might be burst by abrading and diastatic action and the saccharine extract pressed out in a concentrated state leaving if desirable the further operation of brewing and fermenting to be carried on by any one or at any place at a future time. Now as regards the grinding the chief difficulty is the breaking up the matrix of the grain without too much breaking up the husk or spoiling the drainage. The grinding thus described has reference then to grinding the malt or grist commencing with a process of dry grinding and completing the process as a wet process of grinding or the malt or grist may be soaked to toughen the husk and then ground in a sufficient quantity of water to prevent the grist from clogging up the mill. This grinding process may include the screening by

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

gravitation in water and the washing of the husk. It may also include special mills or several pairs of rollers arranged in sets so that the malt or grist may pass through more than one set of rollers. Also the grinding process may include a "kibbling" machine and a kneading machine. The apparatus for mechanically  
5 bursting the starch cells &c may consist of plunging or pumping or screw-delivering apparatus to deliver and propel the mash made with more or less water and from the consistence of a mere paste to that of an ordinary mash where 2 barrels of water are used to one quarter of malt. The apparatus to propel the pasty mash may be constructed to heat the mash in its passage through the apparatus and at  
10 the same time by an abrading action cause the bursting of the cells by the particles rubbing one upon the other while the mass is being propelled through chambers or cones of varying sectional areas. Or the apparatus may consist of an injector system such as described in my patents N° 4277 of 1882 and 1205 of 1883 for the mechanically bursting the starch cells in the presence of the diastase of the malt  
15 without destroying the latter.

The straining and filtering process has reference in the first place to forcing air or any gas into the mash or purified air or passing air into the mash as it is being treated or is passing through the converting apparatus. The object of passing air into the mash being to buoy up the mash so that it may be rendered  
20 porous and light and act as a filter bed. The filtering or pressing process also has reference to constructing an attachment or auxiliary to the converting apparatus or separating or filtering apparatus or arrangement so that the liquid may be strained or forced or pressed away from the solid part more or less and in a clear or semi-clear condition so as to leave the cellulose &c in the "draff" or  
25 "grains." This separating or filtering arrangement may be a press of any kind such as is already in use for other purposes or any special one may be used and into which the converted mash whether in the thick or the thin state may be delivered under any suitable pressure. It may also be constructed of perforated pipes chambers or cones through which the mash is made to travel in a continuous  
30 form in its passage out of the converting apparatus. Or rings of metal placed (in a perforated tube encased in an outer tube with a space between the inner perforated and the outer tube) one upon the other leaving the spaces between them for filtering the liquid away; the rings may have milled or serrated edges to present very fine spaces or a voluted or spiral springs or rings made for instance by  
35 screwing a cylinder and boring away the internal part leaving a spiral piece of metal as the only remaining part. Or perforated or straining chambers or pipes may be lined with fibrous or hair like substance such as flax for instance disposed in the direction of the flow of the "mash." All such chambers pipes or arrangements may have regulating cocks or valves to regulate the amount of liquid to be  
40 strained or pressed away. The strained liquid may be returned to be mixed with fresh mash or malt or grist and so form a very concentrated extract or such a concentration of the extract as may be desired. The straining or pressing or filtering process may also include the rewashing of the "draff" or "grains" after the first pressing and then pressing again so as to deliver the "grains" after being  
45 freed from the saccharine extract finally in a pressed state. Also in the washing may be included the separating of some of the husky part from the grains so as to make them in a more convenient and portable form as food for cattle leaving the rough husky part for any other convenient purpose. The fermenting process may include apparatus consisting of a combination or set of casks having a "back"  
50 placed over them and a "swan neck" pipe arrangement in each such as is in vogue at the present time in Burton on Trent and known as the Burton Union system. But in the place of the "back" above the casks, being intended and used as a "back" to contain the yeast the back is to be constructed for the purpose of containing about one half more or less as much fermenting beer as is contained  
55 in the casks. In the action of this apparatus the yeast from the cask continually is being discharged into the "back" and thereby increasing the quantity of yeast in proportion to the beer contained in the "back." This causes the fermentation

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

in the "back" to proceed more rapidly than the beer in the casks and to finish quicker and settle before the beer in the casks has finished therefore to form a constant supply to fill up the casks with bright beer. It is intended to put into this "back" any suitable attenuator for regulating the temperature. By this process of fermentation the large amount of yeast that accumulates in the "back" 5 does not injure the fermentation to produce a "yeast bite" but on the other hand overcomes the difficulty in a great measure attendant upon fermentation.

Having thus shown the general nature of my invention I also state that any modification of the mashing process whereby the mash or moistened malt is subjected for a shorter period than half an hour to those low temperatures desirable 10 for transforming the albumenoids under the vital or diastatic action that takes place at a lower temperature than that at which germs or spores in the malt are destroyed form a modification of my process and produce a modified beer. Even if the mash is only exposed or the malt is soaked before grinding only for a few minutes and then passed through the converting apparatus so as to give the desired 15 temperature and to rupture the starch cells and cleanse the mash by destroying any organisms, then such treatment forms a part of my process. Finally my process includes the use in the preparation of the "wort" for fermentation of saccharine or maltose extract containing the proper proportion and condition of dextrine of the high class or those dextrines near to maltose, and containing also 20 the requisite quantity and condition of albumenoid substance that has been modified by the action of submitting malt extract or mash to the action of diastase or such action as takes place in mashed or soaked malt when submitted to the initial process of mashing at low temperatures or those below 115° or thereabouts. It is the fermenting of such extract that actually constitutes the making of the 25 beer and the actual carrying out of my process. But as such extract is not a commercial commodity and cannot at present be purchased the brewer must manufacture it for himself until such is manufactured for him. It follows then that the preparation of the extract and the fermenting of the extract are both parts of the same process and the beer as before described cannot be produced unless the 30 extract is first prepared and then afterwards fermented. But inasmuch as the extract may be prepared by or through one person and the fermentation be conducted by another that in order to protect the inventor from infringement such a means of circumventing is not permissible and the process not be split up into the preparation at a certain time and place or by one person the extract and 35 the fermenting it at or by another. I must also state that so little is at present absolutely known in the science of chemistry about the chemistry of the dextrines and the albumenoids that to give the chemical composition of the wort that will express distinctly the condition of these bodies in the "worts" or extract it is not I believe competent for any chemist or for me to give. With regard to the 40 making of spirit it is only necessary to distil such fermented "wort" as has been before described by any ordinary distilling apparatus. But as regards the temperature of such fermentation that may be modified as well as the quantity of yeast employed also distillers who do not produce their own yeast would have to produce it as in the ordinary way. 45

Now in describing the manufacture and processes of making the new kind of beer and the modifications of the same as well as the machinery and apparatus for the purpose of carrying out such manufacture, it is necessary to go more at length into the principles involved and embraced. The principles then embrace in the first place the treatment of the albumenoids by the action upon them at certain 50 temperatures of the nitrogenous bodies of the diastase class and afterwards the treatment of the starchy products in such a manner as to give the requisite proportions of maltose and of dextrines of the high class known as the Achroo dextrines or those near to maltose. To take the first process or the treatment of the nitrogenous bodies—The action varies according to temperature and whether in 55 the presence of the germs or vital organisms naturally present in the malt that is of lactic and other organisms. The temperature at which the germs of yeast and

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

- of acetic acid are said to be destroyed is 122 Fah. The germs of Lactic acid are rendered inert only at this temperature but they are stated to be not destroyed until a temperature in the ordinary way of 230° is reached. At the same time it is possible by submitting malt extract or "wort" to the action of alternating
- 5 pressure velocity concussion and temperature by passing it through my injector apparatus to break up and shatter and destroy these organisms at a temperature below the boiling point of 212°. The temperatures then below 115° constitute those at which the albumenoids may be treated in the presence of the vital organisms natural in malt, and the temperatures varying from about 126 to about
- 10 140° constitute the range of temperatures at which the albumenoids are treated in the presence of the unorganised ferments only—germs or vital organisms being either destroyed or rendered inert. The temperatures between 115° and 126° should be rather avoided as dangerous and likely to produce a "souring" of the "worts." The action then on the albumenoids is different when acted upon by
- 15 those bodies of the diastase class alone than when acted upon by the organised ferments or germs natural in malt as well as the unorganised ferments. The action is different again when malt mash is treated at temperatures below those at which the lactic and acetic germs commence their activity—that is at temperatures below 50 or 60°. The treatment of the albumenoids for the distinctive beer
- 20 should be at temperatures ranging from 60° (about) to 115° and for the modified beer at from 126° (about) to 140° (about). The modified beer includes all the variations from the distinctive beer up to the ordinary type of English beer excepting that the modified beer will be peptonic and digestive and possessing aromatic properties in the place of being harsh, indigestible and wanting in
- 25 aromatic character a fault almost universal in English beer. The importance of obtaining a powerful and healthy ferment and of correctly modifying the albumenoids is paramount as will be seen by the following facts that have come under my observation. The chemistry of beer is very difficult and not at present fully understood but in the ripening process the beer may take either of two lines.
- 30 It may follow either the ether lines or the aldehyde lines. A very healthy ferment produces a digestive and aromatic beer but an unhealthy ferment produces a very weak yeast a beer containing acid and aldehyde and Amyl-Alcohol and altogether wanting in that aromatic quality that is due to the formation of ether. A healthy ferment is produced when the diastatic action on the albumenoids has brought
- 35 about the correct peptonisation and the proportions of dextrine and maltose present on the extract are also correct and of the finest kind and all contamination in the ferment is avoided. There are numerous difficulties to be met with in obtaining a correct result both as regards the action on the albumenoids as well as on the starch. For the temperatures at which the albumenoids are best modified are not
- 40 those best suited for modifying the starch, for instance, the temperatures below 140° give a proper peptonising effect but as regards the conversion of the starch the result according to recent research gives in proportion 80 per cent of maltose to 20 of dextrine. This proportion of dextrine is too small to give a resulting beer full on the palate after having been submitted to a powerful ferment. But at so
- 45 low a temperature a large proportion of the starch cells do not become burst so that a great variety of dextrine is produced part of it being of the Achroo-dextrine kind but a large proportion of the Erythro-dextrine description while there is frequently present in the extract a large quantity of unconverted starch. To obviate some of these difficulties and objections has been the subject of my two
- 50 former patents, the one N° 4277 dated 8<sup>th</sup> September 1882 and relating to the treatment of starchy substances in brewing &c, the other N° 1205 dated 6<sup>th</sup> March 1883 and relating to improvements in brewing. The present invention relates to the still further improving the manufacture of beer so as to make a new product by certain process in the use of the two former inventions combined with the new
- 55 process and apparatus contained in this present invention. In carrying out this invention I adopt sometimes a radical system and sometimes a modified system. The radical system is used when for instance in the building of new breweries

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

customs and prejudices and the usual arrangements of breweries may be disregarded. The modified system is followed out when it is necessary to adapt the invention to existing brewing arrangements and plants. As regards the first system, it includes the grinding of the malt in a moist state and at proper temperatures to produce the correct peptonic effect and to crush the malt perfectly 5 or to break up the matrix of the grain so that no lumps of starch remain in the grist and then the bursting of the starch cells by means of mechanically forcing the mash either with or without the husky part through my injector system or through chambers or pipes of varying sectional area such for instance as a succession of cones. In this process the malt may be submitted to temperature in a moist 10 state so as to modify the albumenoids before crushing or completely crushing. In this system the conversion of the starch by means of the injector apparatus takes place almost instantaneously so that the extract may be at once pressed away in a more or less thick condition and submitted to a dessicating process. This system may be also adopted in making the condensed wort extract by evaporating the extract 15 either before or after the boiling or adding hops. The modified system may be readily applied to existing breweries and it does not necessitate the use of the ordinary internal "rakes." For this system it is only necessary to grind the malt as finely as is compatible with obtaining a proper drainage of the goods and make the mash in an ordinary way with an external masher either a "Steele's" masher 20 or a "self acting masher." The mash, which by preference should be made stiff, should be made at temperatures as before indicated for modifying the albumenoids and according to the kind of beer to be made whether of the distinctive or the modified kind. This initial mash should stand about 20 minutes or half an hour and be then converted at high temperatures by passing through the "Mash 25 Miller" system. The temperatures desirable must be decided by each brewer for himself according to the amount of fulness desirable to be left on the finished beer. Any one referring to a table of temperatures given as the result of chemical research will find that the per centages and kinds of the Achroo dextrines range for the lowest at about 145° and the highest 167° above that temperature the dextrines 30 are of the Erythro dextrine type and at 175 diastase is destroyed. The dextrines change and become lost in certain proportions as the mash is allowed to fall in temperature. The action of the combined "Mash Miller" and "Injector system" is to take the mash from the bottom layer in the mash tun and deposit it as a continuous top layer raising the temperature in its passage so that the top layer is 35 not cooled or altered in temperature. In describing this system Fig. 3 and Fig. 4 show respectively elevation section and plan of mash tun and "Mash Miller." N is a mash tun, O a mash miller, P mash inlet to "miller," Q grain trap, R hollow centre shaft, S, S, S, arms or blades perforated, or some of them, T false bottom, V distributing perforated arms, X metal case containing injector nozzles, Y "Injector 40 system" in conjunction with "mash miller," Z steam cock, Z<sup>1</sup> cleaning cock, Z<sup>2</sup> steam jet pipe, Z<sup>3</sup> hot or cold water pipe with distributing rose attached, X<sup>1</sup> is steam cock, X<sup>2</sup> is wort or draw off cock. The "Mash Miller" may be furnished with any kind of rakes inside it or it may be without rakes in some cases or the rakes in the top or horizontal part may be displaced by a pair of squeezing or crushing rollers to 45 rub or crush the grains and break up the lumpy parts containing starch. The centre shaft R may be hollow and form a tube to convey hot water to the perforated arms S so that hot water may be added if desired while the "mash miller" is at work and so make the bottom layer of mash in the mash tun of any desired consistence and temperature continuously as the mash flows into the "Miller"—V are 50 the ordinary distributor pipes perforated so as to collect the wort from different parts underneath the false bottom. The ring P<sup>1</sup>, which may be perforated or not, is a loose ring placed under the false bottom to prevent the grains from getting under the false bottom. The injector nozzles in X are intended to throw up the thick wort containing starch cells and the smaller fragments or debris of the grains 55 in order to free the bottom layer of the mash and make it more open for "draining" and at the same time to remove the stagnant wort from under the false bottom

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

which would flow partly through the perforated arms into the hollow centre step. The thick wort strained through the bottom straining blade S would be delivered through the hollow centre step and flow into X. To throw the mashing apparatus into action; start on the machinery and set the blades S revolving as well as the spiral or other fans or blades or screws or spars inside in "Miller" and at the same time turn on the steam cock Z to regulate the steam to "injector system" Y. The thick wort will then be sucked out of the "Miller," being strained away from the grains in the miller by means of the perforated inner casing, and the pressure of the liquid mash in the mash tun together with the action of the revolving spars will cause the circulation of the whole mash from bottom to top. A pump may be used to force the thick wort into the injectors Y, or a pressure heater, such as is shown at Fig. 2 may be used to heat the wort in the place of open steam. A pump and a number of cones or abrading nozzles may be used to mechanically break up the starch cells. The top of the pipe Y is intended to have a swivel union so that the liquid part may be delivered either into the top horizontal part of the miller or direct into the mash tun. The pipe Z<sup>3</sup> may be used to "sparge" on hot liquor while the "mash miller" is working when desirable. The following will serve as a specimen of brewing for each beer that is for the distinctive beer and the modified beer. For the distinctive beer make the mash so that the temperature in the mash tun is at, say 100° (but it may range from about 95° to 115°). Let it stand 20 minutes, then set the "miller" and machinery to work and keep the mash in circulation so as to raise the top layer continuously to about 154°, or the mash may be afterwards kept in circulation until the temperature reaches say 160° more or less. "Set tap" in the usual way and "sparge" so as not to allow the temperature to drop. The same directions will serve for the modified beer with the exception that the initial mash should be made so that the temperature taken in the mash tun is about 133° or more or less as before described. The malt in both cases should be well dried and the grist may be all malt or a mixture of prepared raw grain or saccharine matter may be used as in ordinary practice. The "Mash Miller" may be placed inside the mash tun in the place of being outside and may be in the centre or at the side of mash tun. Its form may be varied and it may be made oval shaped to contain more than one set of rakes or beaters. The steam pipe Z<sup>2</sup> may be used to steam the strained grains by blowing in free steam. The grains may be cooled if necessary by adding tepid water. The strength of the beer may vary as may be desirable. The quantity of hops may range from about 4 lbs per qr and upwards. The "attenuation" of the beer may be the same as in ordinary English beer. The temperatures for the modified beer may be the same as in ordinary English fermentations and the quantity of yeast rather less than is generally used. The temperatures for the distinctive beer should not rise higher than 68° and the fermentation must be conducted in small quantities or in flat vessels. The boiling for the modified beer may be the same as for ordinary English beer. The distinctive beer should be boiled for 3 hours. The "pressure heater" may be used to previously heat the wort so as to coagulate the albumenoid matter and separate it by filtration as the wort passes into the copper but pressure need not be used in this case. The pressure heater may also be used to heat the wort after boiling when it is strained away from the hops. In this manner the lactic germs may be destroyed at a temperature of 230° also the albumenoids still remaining may be modified at the same time. When used in this way an exit cock and a pressure gauge or valve should be attached. Fig. 2 shows sectional elevation of heater or a copper coil placed in a strong iron cylinder, I and H show inlet and outlet for wort, K and L inlet and outlet for steam and condense. This heater may be attached to an ordinary boiling "back" so that the wort may be forced by means of a pump from the bottom of the copper and delivered continuously in at the top or near the top of the wort level so as to boil at any temperature above 212°. Fig. 5 is an enlarged sectional elevation of metal case with injector nozzles contained in it having cock *m* for inlet of steam. Fig. 6 shows in plan a nozzle or cone with notches *n* to allow the steam to pass. Fig. 1 shows fermenting

*Lawrence's Improvements in the Manufacture of Beer and Malt Liquors, &c.*

apparatus in which the beer fermenting fills the "back" A up to the level indicated by dotted lines. The barrels or casks also being full. As the fermentation proceeds the yeast and beer thrown out of the casks is replaced by the beer from the back as shown at Fig. 1<sup>A</sup> at B<sup>1</sup> the beer having settled more or less from the "bottoms" and passed through the holes E. F F are sloping yeast boards extending 5 the whole length of the back.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is

1. The process and apparatus for the manufacture of beer "distinctive" or 10 "modified," substantially as herein described and illustrated.
2. The process of bursting the starch cells in malt at temperatures between 154° and 167° after previous modification of the albumenoids by means of the apparatus herein described or otherwise, substantially as herein described.
3. The process of bursting the starch cells by taking the mash continuously 15 from the bottom layer in the "tun" and re-delivering it on the top—heating said mash during transit.
4. Forcing and heating the "wort" under pressure to a temperature of 230° and upwards, substantially as described.
5. The process of separating the liquid from the solid parts of the mash or the 20 grains and heating the liquid and the grains either or both of them and re-delivering them substantially as described.
6. The method of causing a continuous circulation of the mash or "goods" by utilizing the hydrostatic pressure in the mash tun, substantially as described.

Dated this 31st day of December 1885.

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W<sup>M</sup> LAWRENCE.

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